XXX. *Of the geographical situation of the Three Presidencies, Calcutta, Madras, and Bombay, in the East Indies.* By J. GOLDINGHAM, *Esq. F. R. S.*

Read June 27, 1822.

IN the present advanced state of knowledge it may be useless to dwell upon the importance to navigation, as well as to general geography, of correct information relative to the latitudes and longitudes of the principal places on the surface of our globe. The ease with which the situation of a place *on* the meridian is obtained, for general purposes, is well known, and the comparative difficulty of ascertaining the distance, east or west, *from* a given meridian is equally so, particularly where that meridian is a quarter of the globe distant, which is the case as relates to India. Having, however, one point correctly determined, the situations of others, at moderate distances from it, may be come at with greater facility; either by chronometers, by correspondent observations, or, where places are on the same continent, by actual survey.

One of the best methods of determining the position of a point, thus distant from the first meridian, is by eclipses of the satellites of Jupiter. Correspondent observations of eclipses of the sun, of the moon, or of occultations, happen but seldom, and the method by the moon's transit requires, that the position of that luminary should be correctly set down in the Tables; or, in the case of correspondent transits, that the instruments at both places should be most accurately

placed in the meridian, and the transits taken with the least possible error of observation; as only a very small error in the Tables, or in the observed place of the moon, may produce a considerable one in the result. But eclipses of the satellites of Jupiter occur often, and correspondent ones with those taken at Greenwich, are not *very* unfrequent, even in this distant part of the globe. The observations taken at Greenwich also show the difference or error of the Tables, and consequently, the error of the longitude deduced from them. Errors also which may arise from a difference in the powers of the telescopes, and in the eyes of observers, as well as from a general difference in the state of the atmosphere, may be counterbalanced by taking a series of these eclipses, consisting of immersions as well as emersions.

I shall, therefore, for the present at least, as regards the longitude of Madras, draw a conclusion from these eclipses; a very long catalogue of which has been taken at the Madras Observatory. So numerous, indeed, are these observations, that the longitude of Madras, which I may give at a future time, by other methods, may perhaps be considered more as corroborating *that* now deduced, than as furnishing information for correcting it.

We may now, however, notice a result obtained from lunar observations. Of these, about 800 have been taken at various times since the year 1787, with different sextants; and reduced to the Observatory, give its longitude $2' 55,''5$ more than by the satellites. This will furnish us with a correction for numerous observations of this description taken at Bombay, when we come to treat of the longitude of that place.

The first set of the following eclipses is composed of ob-

servations taken at different places in India; the differences of meridians between which and the Observatory are correctly known, either from correspondent eclipses, chronometers, or by survey. These having been taken with different telescopes, and by different observers, and also at a distance from the Observatory, may be considered as less valuable than those observed there, with the same description of telescope, and under every favourable circumstance.

The second result is from eclipses taken at Madras, with different telescopes, at two or three different points, and reduced to the Observatory. These may also be considered of less value than the third result, which is drawn from eclipses taken at the Observatory with the same description of telescope, and under favourable circumstances. I have, therefore, in drawing the conclusion, considered a mean of the first and second results as about equal in value to the third, and have combined them accordingly. The fourth result is from correspondent eclipses, which I considered of equal value with the other three results. This relates to the first series of eclipses from 1787 to 1801.

In the second series, containing eclipses taken between the years 1803 and 1816, the first result was deduced from observations taken at the Observatory with the same description of telescope, and is therefore of equal value with the mean of the two first results, and also with the third of the other series; and the results have been combined accordingly. The second result of the second series is obtained from correspondent eclipses; and, like the former, by observations of this description, is considered of equal value with the mean of all the results found by correcting the Tables.* The differ-

* In drawing the conclusion, I have combined *all* the correspondent eclipses.

ences, applied to the longitude, found by the Tables in the Ephemeris were obtained by eclipses taken at Greenwich, as near the time as possible that each eclipse was observed at Madras.

The following are the observations and results. It may be proper to state, that some additional observations were at first included in these Tables; that a mean was taken; and, when any longitude differed more than 30 seconds from the mean, it was rejected; and it is only these eclipses which were within 30 seconds of the general mean that are here included. The observations being so numerous, enabled me to make this selection. The general result in both cases is however very nearly the same, as is commonly the case; there being found as many rejected observations giving a longitude too great as too little.*

* In finding the difference of the Tables, reference has been made to the circumstance under which the Greenwich observation *nearest* the time was taken, and its value in consequence; as well as to other observations taken *about* the time.

Longitude of the Madras Observatory by the Eclipses of the Satellites of Jupiter, from 1787 *to* 1801, *corrected for the difference of the Tables from the Observations taken at Greenwich at or about the time of each Eclipse.*

Day.	Place.	Satellites.	Apparent Time. Observed at Madras.	Apparent Time. Per Ephemeris.	Longitude in Time.	Difference of the Tables.	Corrected Longitude.	Difference of Longitude to the Observatory.	Longitude of the Observatory.
1787.			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.	m. s.	h. m. s.
Feb. 9	Calcutta.	1 E	8 33 13	2 39 36	5 53 37	+ 14	5 53 51	32 25,2	5 21 25,8
16	——	1 E	10 29 26	4 35 34	5 53 52	+ 14	5 54 6	32 5,2	5 21 40,8
22	——	2 E	8 26 48	2 33 48	5 53 00	+ 1,20	5 54 20	32 28	5 21 54,8
25	——	1 E	6 55 22	1 1 23	5 53 59	+ 14	5 54 13	32 28	5 21 47,8
1789.									
Dec. 17	Coringa.	1 I	17 6 58,5	11 38 41	5 28 17,5	+ 27	5 28 44,5	8 19,7	5 20 24,8
19	——	1 I	11 34 23,2	6 6 9	5 28 14,2	+ 28	5 28 42,2	8 19,7	5 20 22,5
29	——	2 I	13 28 53	8 0 17	5 28 36	+ 12	5 28 48	8 19,7	5 20 28,3
1790.									
Jan. 2	——	1 I	15 14 41,4	9 46 9	5 28 32,4	+ 32	5 29 4,4	8 19,7	5 20 44,7
23	Masulipatam.	2 I	10 15 49	4 51 46	5 24 3	+ 47	5 21 50	3 38,3	5 21 10,3
Feb. 1	——	1 I	17 4 4	11 40 3	5 24 1	+ 39	5 24 50	3 38,3	5 20 0,3
26	——	1 E	13 59 46	8 35 24	5 24 22	+ 48	5 25 10	3 38,3	5 21 30,3
1791.									
Jan. 5	Bombay.	1 I	17 30 54,3	12 40 6	4 50 48,3	+ 30	5 51 18,3	29 38,4	5 20 56,7
7	——	1 I	11 58 2	7 7 42	4 50 20	+ 32	4 50 52	29 38,4	5 20 30,4
Feb. 20	——	1 I	17 41 35	12 50 52	4 50 43	+ 24	4 51 7	29 38,4	5 20 45,4
22	——	1 I	12 10 3	7 19 32	4 50 31	+ 26	4 50 57	29 38,4	5 20 35,4
March 1	——	1 I	14 5 10,5	9 14 43	4 50 27,5	+ 35	4 51 2,5	29 38,4	5 20 40,9
8	——	1 I	16 0 31,5	11 10 21	4 50 10,5	+ 30	4 50 40,5	29 38,4	5 20 18,9
24	——	1 E	16 35 26	11 43 39	4 51 47	+ 19	4 52 6	29 38,4	5 21 44,4
April 4	——	1 E	7 29 30	2 38 16	4 51 14	+ 39	4 51 53	29 38,4	5 21 31,4
11	——	1 E	9 25 39	4 34 87	4 21 2	+ 34	4 51 36	29 38,4	5 21 14,4
18	——	1 E	11 22 31	6 30 47	4 51 44	+ 36, 3	4 52 20,3	29 38,4	5 21 58,7
25	——	1 E	13 17 51,2	8 26 45	4 51 6,2	+ 43	4 51 49,2	29 38,4	5 21 27,6
27	——	1 E	7 46 41,2	2 55 41	4 51 0,2	+ 43	4 51 43,2	29 38,4	5 21 21,6
May 27	——	1 E	9 54 2,8	5 3 18	4 50 44,8	+ 51	4 51 35,8	29 38,4	5 21 14,6
1789.									
Jan. 29	Tranquebar.	2 E	14 21 10	9 1 26	5 19 44	— 12	5 19 32	+1 34	5 21 6
31	——	1 E	10 40 54	5 22 5	5 18 49	+ 1,10	5 19 59	+1 34	5 21 33
Feb. 14	——	1 E	14 29 56	9 10 25	5 19 31	+12, 5	5 19 43,5	1 34	5 21 17,5
23	——	1 E	10 54 17	5 34 36	5 19 41	+12, 5	5 19 33,5	1 34	5 21 27,5
May 28	——	1 E	6 33 4	1 13 20	5 19 44	+ 20	5 20 4	+1 34	5 21 38
1790.									
Jan. 23	——	2 I	10 10 12	4 51 46	5 18 26	+ 1, 6	5 19 32	1 34	5 21 6
25	——	1 I	15 5 52	9 47 23	5 18 29	+38,	5 19 7	1 34	5 20 41
30	——	2 I	12 43 29	7 25 39	5 17 50	+ 1,6	5 18 56	1 34	5 20 30
1787.									
Nov. 19	Madras.	2 I	8 18 54	2 58 8	5 20 46	+ 1, 7	5 21 53	1 2	5 21 51,8
Dec. 21	——	2 E	10 35 57	5 14 3	5 21 54	— 27	5 21 27	1 2	5 21 25,8
28	——	2 E	13 10 10	7 48 32	5 21 38	— 27	5 21 11	1 2	5 21 9,8
1788.									
Jan. 27	——	1 E	13 1 14	7 41 6	5 20 8	+ 50	5 20 58	1 2	5 20 56,8
Feb. 12	——	1 E	11 19 3	5 58 43	5 20 20	+ 50	5 21 10	1 2	5 21 8,8
23	——	2 E	10 1 56	4 42 0	5 19 56	+ 1,14	5 21 10	1 2	5 21 8,8
March 22	——	1 E	10 1 47,8	4 40 53	5 20 54,8	+ 12	5 21 6,8	1 2	5 21 5,6
31	——	1 E	6 28 44,2	1 7 54	5 20 50,2	+ 12	5 21 2,2	1 2	5 21 1
April 23	——	1 E	6 49 43,5	1 28 48	5 20 55,5	— 3	5 20 52,5	1 2	5 20 51,3

Day.	Place.	Satellites.	Apparent Time. Observed at Madras.	Apparent Time. Per Ephemeris.	Longitude in Time.	Difference of the Tables.	Corrected Longitude.	Difference of Longitude to the Observatory.	Longitude of the Observatory.
1788.			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.	s.	h. m. s.
Nov. 5	Madras.	I I	15 44 47,1	10 24 20	5 20 27,1	+ 52	5 21 19,1	5,4	5 21 15,7
14	——	I I	12 5 39,3	6 45 9	5 20 30,3	+ 52	5 21 22,3	5,4	5 21 16,9
28	——	I I	15 48 47,6	10 28 10	5 20 37,6	+ 1, 0	5 21 37,6	5,4	5 21 32,2
30	——	I I	10 16 37,8	4 55 52	5 20 45,8	+ 1, 0	5 21 45,8	5,4	5 21 40,40
1789.									
April 3	——	I E	9 37 3	4 16 27	5 20 36	+ 27	5 21 3	1	5 21 2
26	——	I E	9 56 17,6	4 35 36	5 20 41,6	+ 20	5 21 1,6	1,2	5 21 0,4
1790.									
Jan. 25	——	I I	15 7 51,7	9 47 23	5 20 28,7	+ 38	5 21 6,7	9,4	5 20 57,3
30	——	2 I	12 46 18,1	7 25 39	5 20 39,1	+ 1, 6	5 21 45,1	9,4	5 21 35,7
Feb. 3	——	I I	11 28 48,9	6 8 19	5 20 29,9	+ 40	5 21 9,9	1,2	5 21 8,7
10	——	I I	13 22 13,3	8 1 58	5 20 15,3	+ 40	5 20 55,3	1,2	5 20 54,1
26	——	I E	13 55 29	8 35 24	5 20 5	+ 48	5 20 53	1,2	5 20 51,8
28	——	I E	8 24 25,2	3 4 17	5 20 8,2	+ 48	5 20 56,2	1,2	5 20 55
March 14	——	I E	12 16 39,3	6 56 19	5 20 20,3	+ 32	5 20 52,3	1,2	5 20 51,1
21	——	I E	14 13 00	8 52 45	5 20 15	+ 52	5 21 7	1,2	5 21 5,8
April 6	——	I E	12 35 42,8	7 15 20	5 20 22,8	+ 42	5 21 10,8	1,2	5 21 9,6
8	——	I E	7 4 30,9	1 44 27	5 20 3,9	+ 48	5 20 51,9	1,2	5 20 50,7
15	——	I E	9 0 55,49	3 40 50	5 20 5,4	+ 49	5 20 54,4	1,2	5 20 53,2
22	——	I E	10 57 13,4	5 36 58	5 20 15,4	+ 49	5 21 4,4	1,2	5 21 3,2
1792.									
March 19	——	I I	15 46 24,3	10 25 55	5 20 29,3	+ 54	5 21 23,3	0,2	5 21 23,5
21	——	I I	10 15 37	4 54 57	5 20 40	+ 54	5 21 34	0,2	5 21 34,2
28	——	I I	12 11 21,2	6 51 7	5 20 14,2	+ 48	5 21 2,2	+ 0,2	5 21 2,4
May 13	——	I E	14 52 5,5	9 31 40	5 20 25,5	+ 30	5 20 55,5	+ 0,2	5 20 55,7

The Coringa, Masulipatam, and Tranquebar observations were taken by the late Mr. TOPPING: the Calcutta observations also by the late Mr. TOPPING: the Bombay observations by myself.

At the Madras Observatory.

Day.	Satellites.	Apparent Time. Observed at Madras.	Apparent Time. Per Ephemeris.	Longitude in Time.	Difference of the Tables.	Corrected Longitude.
1793.		h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
March 24	I I	13 7 11	7 46 44	5 20 27	+ 24	5 20 51
31	I I	15 2 57	9 42 32	5 20 25	+ 24	5 20 49
April 7	I I	16 58 46,4	11 38 19	5 20 27,4	+ 50	5 21 17,4
9	I I	11 27 22,9	6 7 16	5 26 6,9	+ 50	5 20 56,9
16	I I	13 3 29,7	8 2 58	5 20 31,7	+ 50	5 21 21,7
May 1	2 I	13 12 46,2	7 53 9	5 19 37,2	+1 34	5 21 11,2

In the Madras observations which follow, sometimes three observers have taken the eclipse, sometimes two; but all the telescopes have the same power, and are exactly of the same construction, having been made by DOLLOND at one and the same time.

The two assistants at the Observatory are Bramins: the head assistant is named SENVASSACHARY, and the second VERDACHARY.

Eclipses from 1794 *to* 1801, *with the same description of Telescope.*

Day.	Place.	Satellites.	Apparent Time. Observed at Madras.	Apparent Time. Per Ephemeris	Longitude in time.	Difference of the Tables.	Longitude of the Observatory.
1794.	Madras		h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
May 5	Observatory.	I I	14 38 47	9 18 53	5 19 54	+ 48	5 20 42
12	——	I I	16 33 14,3	11 13 2	5 20 12,3	+ 1,14	5 21 26,3
21	——	I I	12 55 24,5	7 35 11	5 20 13,5	+ 1,14	5 21 27,5
28	——	I I	14 48 46	9 28 37	5 20 19	+ 1,16	5 21 25
30	——	I I	9 16 39,6	3 56 54	5 19 45,6	+ 1,16	5 21 16
June 4	——	I I	16 41 41,3	11 21 44	5 19 57,3	+ 1,18	5 21 15,3
6	——	I I	11 9 53	5 49 59	5 19 54	+ 1,18	5 21 12
10	——	2 I	16 52 37	11 32 26	5 20 11	+ 1, 2	5 21 13
1795.							
Sept. 4	——	I E	9 57 44,5	4 37 10	5 20 34,5	+ 17	5 20 51,5
11	——	I E	11 55 37,5	6 35 11	5 20 26,5	+23, 6	5 20 50,1
1796.							
July 22	——	I I	10 30 14,9	5 9 28	5 20 46,9	+20, 4	5 21 7,3
29	——	I I	12 24 15	7 3 33	5 20 42	+ 20	5 21 2
Sept. 13	——	I E	15 14 3,6	9 53 8	5 20 55,6	+10, 2	5 21 5,8
1797.							
Oct. 18	——	I E	15 27 59,5	10 7 7	5 20 52,5	+39, 9	5 21 32,4
20	——	I E	9 56 39,3	4 36 9	5 20 30,3	+ 40	5 21 10,3
Nov. 3	——	I E	13 47 55,7	8 27 20	5 20 35,7	+37, 7	5 21 13,4
5	——	I E	8 16 26,7	2 56 6	5 20 20,7	+41, 4	5 21 2,1
12	——	I E	10 11 14,3	4 50 49	5 20 25,3	+49, 2	5 21 14,5
1798.							
Jan. 29	——	I E	6 56 37,3	1 35 51	5 20 46,3	+14, 6	5 21 0,9
Feb. 21	——	I E	7 13 4,8	1 52 21	5 20 43,8	+ 8, 1	5 20 51,9
Oct. 7	——	I I	13 1 48	7 40 24	5 21 24	16	5 21 8
16	——	I I	9 26 12,3	4 4 53	5 21 19,3	12, 5	5 21 6,8
——	——	2 I	11 29 32	6 8 50	5 20 42	+ 3, 4	5 20 45,4
23	——	I I	11 21 24,2	6 0 2	5 21 22,2	— 15	5 21 7,2
30	——	I I	13 15 57,8	7 54 41	5 21 16,8	— 17	5 20 59,8
Nov. 17	——	I E	8 7 14	2 46 45	5 20 29	+ 35	5 21 4
——	——	2 E	13 45 17,8	8 22 26	5 22 51,8	1,18	5 21 33,8
Dec. 12	——	2 E	10 47 12,5	5 25 34	5 21 38,5	—20, 9	5 21 17,6
1799.							
Jan. 16	——	I E	12 1 19,6	6 40 36	5 20 43,6	+ 36	5 21 19,6
18	——	I E	6 29 15,2	1 8 56	5 20 19,2	+ 35	5 20 54,2
25	——	I E	8 23 10,5	3 2 42	5 20 28,5	+ 30	5 20 58,5
Oct. 3	——	I I	14 34 57,6	9 14 1	5 20 56,6	+ 8, 2	5 21 4,8
10	——	I I	16 30 18,7	11 9 26	5 20 52,7	— 0, 7	5 20 52
Sept. 15	——	2 I	13 32 42,6	8 14 34	5 21 8,6	+ 21	5 21 9,6
1800.							
Feb. 6	——	I E	8 4 35,5	2 44 8	5 20 27,5	+ 37	5 21 4,5
13	——	I E	10 0 4,8	4 39 12	5 20 52,8	+ 30	5 21 22,8
March 24	——	I E	8 42 25	3 21 38	5 20 47	0, 0	5 20 47
Nov. 23	——	1 I	12 37 19,2	7 16 37	5 20 42,2	+30, 6	5 21 12,8

Correspondent Eclipses of the Satellites of Jupiter, from the year 1787 *to* 1800.

Day.	Place.	Satellites.	Apparent Time. Observed Place.	Apparent Time. At Greenwich.	Longitude in Time.	Difference of Longitude to the Observatory.	Longitude of the Observatory.
1787.			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
Dec. 21	Madras.	2 E	10 35 57	5 14 30	5 21 27	1,2	5 21 25,8
1789.							
Dec. 19	Coringa	1 I	17 6 58,5	11 38 14	5 28 44,5	8 21,7	5 20 22,8
1790.							
Jan. 25	Madras.	1 I	15 7 51,7	9 46 45	5 21 6,7	1,2	5 21 5,5
Feb. 26	Masulipatam.	1 E	13 59 46	8 34 36	5 25 10	3 39,7	5 21 30,3
March 3	Madras.	2 E	15 20 25,7	9 58 41	5 21 44,7	— 1,2	5 21 43,5
8	——	3 E	12 27 45,5	7 6 39	5 21 6,5	— 1,2	5 21 5,3
21	——	1 E	14 13 00	8 51 53	5 21 7	1,2	5 21 5,8
1791.							
March 1	Bombay.	1 I	14 5 10,5	9 14 8	4 51 2,5	+ 29 38,3	5 20 40,8
——	——	3 I	15 22 12	10 31 15	4 50 57	29 38,3	5 20 35,3
24	——	1 E	16 35 26	11 43 20	4 52 6	29 38,3	5 21 44,3
April 25	——	1 E	13 17 51,2	8 26 2	4 51 49,2	29 38,3	5 21 27,5
1792.							
March 19	Madras.	1 I	15 46 24,3	10 25 19	5 21 5,3		5 21 5,3
April 11	——	1 I	16 3 35	10 42 55	5 21 00		5 21 00
1793.							
May 8	Masulipatam.	2 I	15 50 11,4	10 25 36	5 20 35,4	3 39,7	5 20 55,7
1794.							
June 10	Madras Observatory.	2 I	16 52 37	11 31 24			5 21 13
1796.							
Sept. 13.	——	1 E	15 14 3,6	9 52 57,8			5 21 5,7
1797.							
Oct. 18	——	1 E	15 27 59,5	10 6 25			5 21 34,5
1798.							
Nov. 15	——	1 E	13 39 55,5	8 17 53,1			5 22 2,4
Dec. 12	——	2 E	10 47 12,5	5 25 54,8			5 21 17,7
1799.							
Jan. 16	——	1 E	12 1 19,6	6 40 02			5 21 19,4
Oct. 10	——	1 I	16 30 18,7	11 9 26,7			5 20 52

RESULTS

By the First and Second Satellites, observed at different places in India, but reduced to the Madras Observatory. Longitude by

Immersions.	Emersions.
h. m. s.	h. m. s.
5 20 24, 8	5 21 25, 8
20 22, 5	21 40, 8
20 28, 3	21 54, 8
20 24, 7	21 47, 8
21 11, 7	21 31, 7
21 1, 7	21 44, 4
20 56, 7	21 31, 4
20 30, 4	21 14, 4
20 45, 4	21 58, 7
20 35, 4	21 27, 6
20 40, 9	21 21, 6
20 18, 9	21 14, 2
21 6, 0	21 6, 0
20 41, 0	21 33, 0
20 30, 0	21 17, 5
	21 27, 5
	21 38, 0
5 20 41,23	21 31,48
	20 41,23
	Mean 5 21 6,35 E

RESULTS

First and Second Satellites observed at Madras. Longitude by

Immersions.	Emersions.
h. m. s.	h. m. s.
5 21 51, 8	5 21 25, 8
21 13, 7	21 9, 8
21 16, 9	20 56, 8
21 32, 2	21 8, 8
21 40, 4	21 8, 8
20 57, 3	21 5, 6
21 35, 7	21 1, 0
21 8, 7	20 51, 3
20 54, 1	21 2, 0
21 23, 5	20 0, 4
21 34, 2	20 51, 8
21 2, 4	20 55, 0
20 51, 0	20 51, 1
20 49, 0	20 5, 8
21 17, 4	21 9, 6
20 56, 9	20 50, 7
20 21, 7	20 53, 2
21 11, 2	21 3, 2
	20 55, 7
5 21 15,45	5 21 1,39
	21 15,45
	Mean 5 21 8,42

RESULTS

By Eclipses from 1794 *to* 1801. *First and Second Satellites observed at Madras, with the same Telescope. Longitude by*

Immersions.	Emersions.
h. m. s.	h. m. s.
5 20 42, 0	5 20 51, 5
21 26, 3	20 50, 1
21 27, 5	21 5, 8
21 25, 0	21 32, 4
21 1, 6	21 10, 3
21 15, 3	21 13, 4
21 12, 0	21 2, 1
21 13, 0	21 14, 5
21 7, 3	21 0, 9
21 2, 0	20 51, 9
21 8, 0	21 4, 0
21 6, 8	21 33, 8
20 45, 4	21 17, 6
21 7, 2	21 19, 6
20 59, 8	20 54, 2
21 29, 6	20 58, 5
21 4, 8	21 4, 5
20 52, 0	21 22, 8
21 12, 8	20 47, 0
5 21 8,34	5 21 7, 1
	21 8,34
	Mean 5 21 7,72

RESULTS.

Correspondent Eclipses from 1787 *to* 1800. *First, Second, and Third Satellites. Longitude by*

Immersions.	Emersions.
h. m. s.	h. m. s.
5 20 22, 8	5 21 25, 8
21 5, 5	21 30, 3
20 40, 8	21 43, 5
20 35, 3	21 5, 3
21 5, 3	21 5, 8
21 0, 0	21 44, 3
20 55, 7	21 27, 5
21 13, 0	21 5, 8
21 52, 0	21 34, 5
	22 2, 4
	21 17, 7
	21 19, 4

Longitude of the Observatory by correcting the Tables, from 1803 *to* 1815.

Date.	Satellites.	Immersions or Emersions.	Mean Time by the Nautical Almanac.	Mean Time observed at Madras.	Longitude of Madras by Tables.	Difference of the Tables.	Longitude of Madras.
1803.			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
Feb. 1	1	Im.	6 1 52	11 23 14,53	5 21 22,43	o 18,0	5 21 4,4
18	2	Im.	8 5 34	13 27 1,39	5 21 27,39	o 28,0	5 20 59,4
March 15	2	Im.	5 5 33	10 26 35,37	5 21 2,37	o 28,0	5 20 34,4
April 2	2	Em.	2 11 22	7 32 18,48	5 20 56,48	+o 24,0	5 21 20,5
20	1	Em.	5 6 25	10 27 32,30	5 21 7,30	—o 21,0	5 20 46,3
27	1	Em.	7 0 45	12 21 46,86	5 21 1,66	—o 21,0	5 20 40,6
May 13	1	Em.	5 18 17	10 39 19,66	5 21 2,66		
20	1	Em.	7 12 47	12 33 55,26	5 21 8,26		
July 7	1	Em.	2 6 1	7 27 20,01	5 21 19,01	+o 6,0	5 21 25,0
1804.							
Jan. 12	1	Im.	8 44 19	14 5 7,60	5 20 48,60		
26	1	Im.	12 31 8	17 15 10,15	5 21 2,15		5 21 6,7
April 22	1	Em.	7 52 54	13 14 13,19	5 21 19,19	+o 4,5	5 21 24,7
24	1	Em.	2 21 23	7 42 42,67	5 21 19,67		5 21 24,2
May 1	1	Em.	4 15 41	9 36 40,83	5 20 59,33		5 21 4,3
4	2	Em.	2 45 28	8 6 51,90	5 21 23,90	+o 9,5	5 21 33,4
8	1	Em.	6 10 3	11 30 41,90	5 20 38,90		5 20 48,4
1805.							
March 10	1	Im.	8 15 31	13 36 34,63	5 21 3,63		
23	2	Im.	10 33 21	15 55 11,66	5 21 50,66		
24	1	Im.	12 2 28	17 23 25,33	5 20 57,33		
26	1	Im.	6 30 54	11 51 50,60	5 20 56,60		
April 2	1	Im.	8 24 32	13 45 25,56	5 20 53,56		
18	1	Im.	6 40 25	12 1 18,63	5 20 53,63		
25	1	Im.	8 34 21	13 55 11,33	5 20 50,33		
May 4	1	Im.	4 57 0	10 18 17,34	5 21 17,34		
July 21	1	Em.	4 7 35	9 28 4,35	5 20 29,35		
28	1	Em.	6 2 42	11 23 24,26	5 20 42,26		
1806.							
Feb. 18	1	Im.	11 6 43	16 27 34,86	5 20 51,86		
April 14	1	Im.	7 44 31	13 5 0,71	5 20 29,71		
18	2	Im.	9 0 9	14 21 47,09	5 21 38,09		
21	1	Im.	9 37 57	14 58 50,76	5 20 53,76		
May 14	1	Im.	9 47 11	15 7 53,87	5 20 42,87	+o 34,0	5 21 16,9
27	2	Im.	11 6 52	16 28 55,43	5 22 3,43		
Sept. 4	2	Em.	1 46 52	7 7 43,26	5 20 51,26	+o 12,0	5 21 3,2
Oct. 6	2	Em.	1 28 30	6 49 16,34	5 20 46,34	—o 22,0	5 21 8,3
1807.							
May 3	1	Im.	9 11 7	14 32 19,06	5 21 12,06		
10	1	Im.	11 4 31	16 25 40,30	5 21 9,30		
26	1	Im.	9 19 47	14 41 3,23	5 21 16,23		
June 2	1	Im.	11 13 22	16 34 32,96	5 21 10,96		
Aug. 11	2	Em.	6 53 31	12 14 41,88	5 21 10,88	+o 15,5	5 21 26,4
29	2	Em.	1 21 19	6 42 12, 8	5 20 53, 8		5 21 9,3
30	1	Em.	1 20 20	6 41 8, 6	5 20 48, 6	+o 15,5	5 21 4,1
Oct. 6	1	Em.	5 27 36	10 48 26, 1	5 20 50, 1	+o 8,0	5 20 58,1
22	1	Em.	3 48 10	9 9 2,	5 20 50, 0	—o 3,2	5 20 48,8
Nov. 7	1	Em.	2 8 52	7 29 40,	5 20 47, 0	+o 1,4	5 20 48,4
1808.							
May 21	1	Im.	10 53 36	16 14 40,18	5 21 4,18		
June 13	1	Im.	11 2 31	16 23 43,57	5 21 12,57		
22	2	Im.	12 5 34	17 26 29,67	5 20 55,67		
29	1	Im.	9 18 9	14 39 22,54	5 21 13,54		

Date.	Satellites.	Immersions or Emersions.	Mean Time by the Nautical Almanac.	Mean Time observed at Madras.	Longitude of Madras by Tables.	Difference of the Tables.	Longitude of Madras.
1808,			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
Sept. 17	1	Em.	2 57 48	8 18 15,16	5 20 27,16	+0 24,5	5 20 51,7
24							
Oct. 26	1	Em.	1 32 53	6 54 0,83	5 21 7,83	—0 12,0	5 20 55,8
Nov. 9	1	Em.	5 24 37	10 45 39,37	5 21 2,37	. . .	5 21 2,4
1809.							
Aug. 26	1	Im.	9 38 18	14 59 22,31	5 21 4,31	—0 19,1	5 20 45,2
Oct. 22	1	Em.	3 1 58	8 23 1,32	5 21 3,32	. . .	5 21 3,3
Nov. 5	1	Em.	6 52 11	12 13 14,46	5 21 3,46	+0 2,0	5 21 5,5
7	1	Em.	1 20 58	6 42 2,04	5 21 4,04	+0 3,5	5 21 7,5
14	1	Em.	3 16 19	8 37 26,98	5 21 7,98	+0 4,8	5 21 12,8
Dec. 4	2	Em.	5 8 22	10 28 37,28	5 20 15,28	+0 50,3	5 21 5,5
7	1	Em.	3 32 10	8 53 9,75	5 20 59,75	+0 2,0	5 20 59,9
23	1	Em.	1 52 51	7 14 1,27	5 21 10,27	+0 1,5	5 21 11,8
29	2	Em.	2 15 46	7 36 15,20	5 20 29,20		
30	1	Em.	3 48 50	9 10 4,25	5 21 14,25	+0 1,0	5 21 15,2
1810.							
Jan. 30	2	Em.	1 58 10	7 18 42,93	5 20 32,93		
March 3	2	Em.	1 39 14	7 0 5,25	5 20 51,25	+0 12,4	5 21 3,7
June 10	2	Im.	11 44 27	17 5 20,07	5 20 53,07		
July 30	1	Im.	11 13 50	16 34 48,95	5 20 58,95		
Oct. 9	1	Im.	6 9 57	11 30 55,63	5 20 58,63	0 6,7	5 20 51,9
Nov. 21	2	Em.	2 15 16	7 35 49,93	5 20 33,93		
28	2	Em.	4 52 56	10 13 17,72	5 20 21,72		
Dec. 3	1	Em.	5 2 44	10 23 31,81	5 20 47,81	+0 23,8	5 21 11,6
1811.							
Jan. 4	1	Em.	1 41 2	7 1 30,77	5 20 28,77	+1 0,3	5 21 28,8
11	1	Em.	3 36 33	8 57 7,86	5 20 34,86	+1 0,3	5 21 35,2
24	2	Em.	1 52 15	7 12 43,12	5 20 28,12	+1 6,0	5 21 34,1
31	2	Em.	4 29 15	9 49 19,04	5 20 4,04	+1 6,0	5 21 10
Feb. 25	2	Em.	1 37 40	6 57 57,54	5 20 17,54	+1 6,0	5 21 23,5
March 29	2	Em.	1 20 10	6 39 58,61	5 19 48,61	+1 6,0	5 20 54,6
Oct. 12	1	Im.	9 37 4	14 58 22,99	5 21 18,99	+0 2,4	5 21 21,4
Nov. 11	2	Im.	9 44 25	15 6 54,36	5 22 29,36	—0 56,1	5 21 33,3
	1	Im.	11 39 6	17 0 15,28	5 21 9,28	+0 5,6	5 21 14,9
Dec. 6	1	Im.	6 16 55	11 37 43,76	5 20 48,76		5 20 54,3
	2	Im.	6 52 49	12 14 23,57	5 21 34,57		
31	2	Em.	6 46 28	12 7 17,03	5 20 49,03	+0 5,6	5 20 54,6
1812.							
Jan. 14	1	Em.	6 56 38	12 17 6,94	5 20 28,94	+0 19,0	5 20 47,9
21	1	Em.	8 51 23	14 11 57,31	5 20 34,31	+0 24,0	5 20 54,3
Feb. 1	2	Em.	6 35 36	11 55 30,48	5 19 54,48		
6	1	Em.	7 9 59	12 30 33,79	5 20 34,79	+ 32,4	5 21 7,2
22	1	Em.	5 29 11	10 49 44,04	5 20 33,04		5 21 5,4
26	2	Em.	3 47 9	9 7 9,23	5 20 0,23		
March 2	1	Em.	1 53 17	7 13 47,50	5 20 30,50		5 20 47,3
16	1	Em.	5 44 6	11 4 46,49	5 20 40,49	+ 16,8	5 20 57,3
25	1	Em.	2 8 26	7 29 28,86	5 21 2,86		5 21 19,7
Oct. 7	1	Im.	10 57 17	16 19 9,65	5 21 52,65		
30	1	Im.	11 6 0	16 27 5,50	5 21 5,50		
Nov. 4	2	Im.	8 42 5	14 3 59,53	5 21 54,53	—4 6,8	5 21 7,7
11	2	Im.	11 16 57	16 38 46,31	5 21 49,31		5 21 2,5
Dec. 15	1	Im.	11 22 43	16 43 50,24	5 21 7,24		5 21 6,1
17	1	Im.	5 51 3	11 12 9,32	5 21 6,32	— 1,1	5 21 5,2
31	1	Im.	9 38 4	14 59 12,46	5 21 8,46		5 21 7,4

Date.	Satellites.	Immersions or Emersions.	Mean Time by the Nautical Almanac.	Mean Time observed at Madras.	Longitude of Madras by Tables.	Difference of Tables.	Longitude of Madras.
1813.			h. m. s.	h. m. s.	h. m. s.	m. s.	h. m. s.
Jan. 2	1	Im.	4 6 30	9 27 13,81	5 20 43,81		
7	2	Im.	8 2 42	13 23 46,62	5 21 4,62		
	1	Im.	11 31 42	16 52 36,75	5 20 54,75		
25	2	Em.	5 27 49	10 48 42,74	5 20 53,74		
Feb. 1	2	Em.	8 4 53	13 25 26,74	5 20 33,74		
10	1	Em.	4 47 55	10 8 56,35	5 21 1,35	+ 8,5	5 21 9, 8
19	2	Em.	2 38 41	7 59 6,12	5 20 25, 1	+ 11,9	5 20 37, 0
26	1	Em.	3 5 9	8 26 26,55	5 21 7, 5	} + 8,5 {	5 21 16, 0
March 5	1	Em.	4 59 53	10 20 37,67	5 20 44, 6		5 20 53, 1
12	1	Em.	6 54 34	12 15 21,18	5 20 47, 2		5 20 55, 7
21	1	Em.	3 17 58	8 39 15,40	5 21 17, 4	+ 8,5	5 21 25,9
23	2	Em.	2 26 47	7 47 29,87	5 20 42,87	+ 11,9	5 20 54,8
30	2	Em.	5 4 11	10 25 32,22	5 21 21, 2	+ 11,9	5 21 33, 1
April 24	2	Im.	2 14 45	7 35 41,48	5 25 56, 4	+ 11,9	5 21 8, 3
29	1	Em.	1 50 9	7 11 1,16	5 20 52, 1	+ 8,5	5 21 0, 6
May 22	1	Em.	2 4 2	7 25 22,66	5 21 20, 6	+ 8,5	5 21 29, 1
26	2	Em.	1 59 5	7 19 57,82	5 20 52, 8	+ 11,9	5 21 4, 7
Oct. 26	1	Im.	12 14 6	7 35 28,47	5 21 22, 4	— 20,9	5 21 1, 5
Dec. 20	1	Im.	8 53 23	14 14 56,75	5 21 33, 7	— 22,2	5 21 11, 5
1814.							
Jan. 1	2	Im.	6 46 56	12 8 56,42	5 22 0, 4	— 50,8	5 21 0, 6
19	1	Im.	10 55 16	16 16 32,23	5 21 16, 2	} — 15,6 {	5 21 0, 6
28	1	Im.	7 17 12	12 38 36,01	5 21 24, 0		5 21 8, 4
Feb. 2	2	Im.	6 23 34	11 45 37,82	5 22 3, 8	— 59,5	5 21 4, 3
4	1	Im.	9 10 49	14 31 59,37	5 21 10, 3	}	5 21 22, 3
6	1	Im.	3 39 12	9 0 10,68	5 20 58, 6	} + 12,0 {	5 21 10, 6
13	1	Em.	5 32 56	10 54 6,43	5 20 10, 4		5 21 22, 4
March 10	1	Em.	2 25 54	7 46 46,83	5 20 52, 8	}	5 21 4, 8
17	1	Em.	4 19 58	9 41 10,77	5 21 12, 7	} + 12,0 {	5 21 24, 7
24	1	Em.	6 14 9	11 35 39,80	5 21 30, 8	+ 12,0	5 21 42, 8
31	2	Em.	6 0 27	11 21 8,95	5 20 41, 9		
April 2	1	Em.	2 37 1	7 58 20,97	5 21 19,97	}	5 21 18, 4
9	1	Em.	4 31 24	9 53 0,91	5 21 36, 9	} — 0,6 {	5 21 36, 3
May 2	1	Em.	4 43 36	10 4 57,03	5 21 21, 0	— 0,6	5 21 20, 4
	2	Em.	4 48 33	11 10 6,13	5 21 33, 0	. . .	5 21 32, 5
June 10	2	Em.	3 14 12	8 35 10,97	5 20 59, 0	— 0,6	5 20 58, 4
Nov. 7	1	Im.	11 29 44	6 50 48,62	5 21 4, 6		
1815.							
Jan. 31	1	Im.	10 11 51	15 33 4,95	5 21 13, 9	}	5 20 56, 6
Feb. 7	1	Im.	12 5 20	17 26 34,74	5 21 14, 7	} — 17,3 {	5 20 57, 4
9	1	Im.	6 33 46	11 54 59,62	5 21 13, 6		5 20 56, 3
10	2	Im.	10 15 53	15 37 59,42	5 22 6, 4	—1 9,7	5 20 56, 7
25	1	Im.	4 49 19	10 10 28,43	5 21 9, 4	— 17,3	5 20 52, 1
28	2	Im.	4 40 42	10 2 46,48	5 22 4, 4	1 9,7	5 20 54, 7
March 4	1	Im.	6 43 2	12 4 12,23	5 21 10, 2	17,3	5 20 52, 9
14	2	Im.	9 49 39	15 11 41,74	5 22 2, 7	1 9,7	5 20 53, 0
Apri 3	1	Em.	10 57 53	16 19 38,57	5 21 45, 5	27,6	5 21 17, 9
12	1	Em.	7 20 26	12 42 1,54	5 21 35, 5	27,6	5 21 7, 9
April 14	1	Em.	1 49 0	7 10 18,98	5 21 19, 0	27,6	5 20 51, 4
19	2	Em.	1 18 54	6 40 37,22	5 21 43, 2	1 3,0	5 20 40, 2
28	1	Em.	5 37 27	10 58 56,64	5 21 29, 6	} 27,6 {	5 21 2, 0
May 5	1	Em.	7 31 48	12 53 26,69	5 21 38, 6		5 21 11,11

The eclipses from 1805 to 1811, were observed during my absence in England; Captain WARREN, of His Majesty's 33d regiment, acting for me.

By correspondent Eclipses of the Satellites of Jupiter at Madras and Greenwich, from 1803 *to* 1815.

Date.	Satellites.	Immersions or Emersions.	Mean Time at Madras.	Mean Time at Greenwich.	Longitude.
1810.			h. m. s.	h. m. s.	
Aug. 22	1	Im.	16 44 2,80	11 22 47,5	5 21 15, 3
1811.					
Nov. 20	1	Im.	13 22 0,47	8 0 57,3	5 21 3,17
1812.					
Nov. 22	1	Im.	16 35 23,14	11 14 3,5	5 21 19,64
1813.					
March 12	1	Em.	12 15 21,18	6 54 12,3	5 21 8,88
1814.					
Feb. 4	1	Im.	14 31 59,37	9 10 53,4	5 21 5,97
April 7	2	Em.	13 58 34,63	8 37 6,8	5 21 27,83
1815.					
Feb. 7	1	Im.	17 26 34,74	12 5 37,3	5 20 57,44
March 14	2	Im.	15 11 41,74	9 50 48,7	5 20 53,04
April 3	1	Em.	16 19 38,57	10 58 3,2	5 21 35,37

RESULTS

By the First Satellite.

Immersions.			Emersions.		
h.	m.	s.	h.	m.	s.
5	21	4,4	5	20	46, 3
	21	6,7		20	40, 6
	21	16,9		20	25, 0
	20	45,2		21	24, 7
	20	51,9		21	24, 2
	21	21,4		21	4, 3
	21	14,9		20	48, 4
	20	54,3		21	4, 1
	21	6,1		20	58, 1
	21	5,2		20	48, 8
	21	7,4		20	48, 4
	21	1,5		20	51, 7
	21	11,5		20	55, 8
	21	0,6		21	2, 4
	21	8,4		21	3, 3
	21	22,3		21	5, 5
	21	10,6		21	7, 5
	21	22,4		21	12, 8
	20	56,6		20	59, 9
	20	57,4		21	11, 8
	20	56,3		21	15, 2
	21	52,1		21	11, 6
	20	52,9		21	28, 2
				21	35, 2
Mean	5	21 3,50		20	47, 9
				20	54, 3
				21	7, 2
				21	5, 4
				20	47, 3
				20	57, 3
				21	19, 7
				21	9, 8
				21	16, 0
				21	53, 1
				20	55, 7
				20	25, 9
				20	0, 6
				20	29, 1
				21	4, 8
				21	24, 7
				21	18, 4
				21	36, 3
				21	20, 4
				20	58, 4
				20	17, 9
				21	7, 9
				20	51, 4
				20	2, 0
				21	11, 0
			5	21	6,86
			5	21	3,50
			Mean	5	21 5,18

By the Second Satellite.

Immersions.			Emersions.		
h.	m.	s.	h.	m.	s.
5	20	59, 4	5	21	20, 5
	20	34, 4		21	33 ,4
	21	33, 3		21	3, 2
	21	7, 7		21	8, 3
	21	2, 5		24	26, 4
	21	0, 6		21	9, 3
	21	4, 3		21	5, 5
	20	56, 7		21	3, 7
	20	54, 7		21	34, 1
	20	53, 0		21	10, 0
				21	23, 5
5	21	0 67		20	54, 6
				20	54, 6
				20	37, 0
				20	54, 8
				21	33, 1
				21	8, 3
				21	4, 7
				21	32, 5
				20	40, 2
			5	21	9,88
			5	21	0,67
			Mean	5	21 5, 3

RESULTS

By the correspondent Eclipses from 1803 *to* 1816.

h.	m.	s.
5	21	15,30
	21	3,17
	21	19,64
	21	8,88
	21	5,97
	21	27,83
	20	57,44
	20	53,04
	21	35,37

Correspondent Eclipses from 1787 *to* 1816.

Immersions.				Emersions.			
h.	m.	s.		h.	m.	s.	
5	20	22, 8		5	21	25, 8	
	21	5, 5			21	30, 3	
	20	40, 8			21	43, 5	
	20	35, 3			21	5, 3	
	21	5, 3			21	5, 8	
	21	0, 0			21	44, 3	
	20	55, 7			21	27, 5	
	21	13,			21	5, 7	
	20	52,			21	34, 5	
	21	15, 3			22	2, 4	
	21	3,17			21	17, 7	
	21	19,64			21	19, 4	
	21	5,97			21	8,88	
	20	57,44			21	27,83	
	20	53,04			21	35,37	
5	20	57,66	Mean.	5	21	26,28	Mean.
	21	26,28	Emersions.				
	21	11,97	Mean.				

Longitude of the Madras Observatory from the whole of the foregoing Observations. By correcting the Tables:

First and Second Satellites.

	h. m. s.		h. m. s.
Eclipses reduced to Madras,	5 21 6,35		
Observed at Madras, but not with the same telescope,	5 21 8,42	Mean	5 21 7,77
Observed at Madras to 1802, with the same description of telescope,			5 21 7,72
From 1802 to 1815, with telescopes of the same powers,			5 21 5,24
Mean by correcting the tables,			5 21 6,78
By correspondent observations at Greenwich, from 1787 to 1816,			5 21 11,97
Mean, or longitude of the Observatory,			5 21 9, 4
		East of Greenwich	80 17 21

Fort St. George Church-steeple is 2′ 21″ east of the Observatory; the longitude of the Steeple is therefore 80° 19′ 42″ east.

The longitude of the lunar observations before alluded to, about 800 in number, taken between the years 1787 and 1792* at different parts of Madras and at Coringa, and reduced to the Observatory, is 80° 20′ 16″,5 east; and therefore, according to the eclipses, 2′ 55″,5 too great.

* By the late Honourable W. Petrie, Esq. the late Mr. Topping, and myself: the Coringa observations by Mr. Topping.

I shall now proceed to give some information respecting the latitude of the Observatory. The height of the pale at Madras being only 13 degrees, the method by circumpolar stars cannot be used; and the latitude has been found by meridianal observations of the sun and stars north and south of the zenith, taken with the sextant, a circular instrument of 18 inches diameter by TROUGHTON, and the zenith sector used in Colonel LAMBTON's Survey.

The results were as follow:

Latitude of the Madras Observatory by observations of stars with the sextant, - -		13° 4′ 8″,606
With the circular instrument, stars north and south of the zenith, -	13° 4′ 11″,894	
Second set, - - -	13 4 6 ,770	13 4 9,332
Stars near the zenith, - - -		13 4 7,917
Correspondent observations of the sun at Greenwich, - - - - -		13 4 11,163
Observations of the sun, - - -		13 4 5,363
Mean by the circular instrument and sextant, - - - - -		13 4 8,476
By observations with the zenith sector, stars north and south of the zenith, - - -	13 4 11 , 95	
Sun, - - - -	4 5 , 15	13 4 8, 55
Mean latitude by Mr. GOLDINGHAM's observations, - - -		13 4 8,513

During my absence in England, I find the zenith sector was again brought to the Observatory, there being some doubt, as it would seem, of the correctness of the foregoing

conclusion.* The following are the results of the observations, which are very numerous.

By Captain WARREN's observations with the zenith sector.

Latitude, stars north and south of the zenith,

Table II. of the Records, -	13° 4′ 15″,074		
Table III. - - -	4 13 ,717	° ′ ″	
Mean by stars - - -		13 4 14,395	
by the sun - - - -		4 5,483	
Mean latitude by Captain WARREN's Observations - - -		13 4 9,939	
Mean latitude by both; Mr. GOLDINGHAM with the circular instrument and sextant - - -		13 4 8,479	
Zenith sector, Stars - - -		11,950	
Sun - - -		5,150	
Captain WARREN's, zenith sector,			
Stars - - - - -		14,395	
Sun - - - - -		5,483	
Mean latitude† -		13 4 9,1N.	

It would therefore appear that very little (if any) additional light had been thrown upon the subject by the latter obser-

* Owing, probably, to the difference between the latitude by the sun, and that by the stars; a difference, however, much greater in the latter observations than in the others; and, as I have observed, not easily accounted for. I hope, however, that the Observatory will be furnished with a large circle, which, besides enabling us to obtain other valuable information, may lead to a discovery of the cause of this difference.

† This result is found from about 700 observations.

vations; those formerly taken,* differing from the mean of the whole little more than half a second. The mean of the whole, 13° 4′ 9″,1,† may therefore be considered, for the present at least, the latitude of the Observatory.

It will be observed, that the meridianal observations of the sun give a different result from those of the stars. In mine, this difference is about 4 seconds less than by the stars; in the second series, the difference is nearly 9 seconds also less than by the stars; a difference not easily accounted for. It is curious however to remark, that the correspondent meridianal zenith distances of the sun at Greenwich, give a result *greater* than the mean latitude by the sun 5″,85; and the same elements are used in both cases, with the exception of declination.

Of the Longitude‡ of Calcutta.

By a series of correspondent eclipses of the satellites of Jupiter, taken in Fort William, by the late Lieutenant-Colonel COLEBROOKE, of the Bengal Establishment; the telescope at the Observatory, and that used at Calcutta, being in all

* The observations being so numerous, in the conclusions now drawn from mine, the method of selection used with the eclipses has been adopted, viz. by taking a mean of the whole, and then rejecting those results which differ more than the power of the instrument would seem to warrant: this, with the sextant, I have considered 10″, with the circular instrument 8″, and with the zenith sector 4″. The latitude formerly deduced stood thus: mean of the observations with the zenith sector 13° 4′ 8″,55; with the circular instrument 13° 4′ 8″,40; with the circular instrument and sextant 13° 4′ 8″,5; mean 13° 4′ 8″,48 or not one-tenth of a second different from the result now deduced by these observations.

† Fort St. George Church Steeple is 36″ N. of the Observatory. Latitude of the Steeple is therefore 13° 4′ 45″ N.

‡ According to RENNELL's Memoir, the Longitude by the Honourable THOMAS HOWE, was 88° 33′; by mean of four observers, 88° 27′ 45″.

respects alike, the difference of longitude was found to be 8° 6′ 18″.

Longitude of the Madras Observatory	80° 17′ 21″
Calcutta (Fort William) E. of the Observatory . . .	8 6 18
Longitude of Fort William* . .	88 23 39 E.

Of the Longitude of Bombay.

In the year 1791, being at Bombay, on my way from England to Madras, and aware that great doubts existed as to the longitude of that important commercial station,† I proposed taking some observations, while detained there for a passage to this coast, with the view of assisting in the determination of the question; and accordingly commenced observing the eclipses of the satellites of Jupiter, and a series of lunar observations; taking also at the same time a sufficient number of meridianal observations for determining the latitude. The results were as follow:

By the mean of about 160 lunar observations with a sextant by TROUGHTON, the longitude of the place of observation at Bombay was 72° 57′ 39″ E.; and by the mean of 180 lunar observations with a sextant, having RAMSDEN's name on it, the longitude of the place was 72° 57′ 55″. The mean of both was 72° 57′ 47″.

But it would appear from the lunar observations taken at

* The latitude of Calcutta is considered 22° 33′ N.

† Mr. HOWE's longitude, 72° 38′, appearing at the time to be considered the most correct; but Captain HUDDART had placed it more than a quarter of a degree farther to the eastward.

Madras, that the tables about that period gave $2'\,55'',5$ too much. If, therefore, this quantity be subtracted from the result, the longitude will be only $72^\circ\,54'\,52''$ E.

More than 30 eclipses of the satellites of Jupiter, immersions as well as emersions, were also observed; and by allowing for the difference of the tables at that period by comparisons with Greenwich observations, the longitude of the place of observations, by the mean of the first and second satellites, was $72^\circ\,53'\,26''$.

Also, by a very good chronometer, the rate of which I found before leaving Bombay, and after my arrival at Madras* (having been about 16 days on the passage), the difference of the longitude between the place of observation at Bombay and the Madras Observatory is . $7^\circ\,24'\,12''$

This gives for the longitude of the former $7^\circ\,53'\,9''$

The longitude of Bombay (place of observation) by the lunar observations corrected . .	72 54 52
By eclipses of the satellites of Jupiter, Tables corrected	72 53 26
By the difference of longitude by the chronometer	72 53 9
Mean	72 53 49

But the place of observation was 54 seconds of a degree west of Bombay Church, and 13 east of the Light House; therefore the longitude of the Church, by these observations, is $72^\circ\,54'\,43''$, and of the Light House, $72^\circ\,53'\,36''$ east of Greenwich.†

* Rate on quitting Bombay $+\,40'',43$
On my arrival at Madras $+\,40,\,34$.

† The difference of meridians between Madras and Bombay Churches, according to these deductions, is $7^\circ\,24'\,59''$.

The latitude was found by 32 meridianal observations of the sun and stars, north and south of the zenith, taken with the two sextants, and an artificial horizon. The height of the thermometer and that of the barometer was noted at the time of each observation, and the correction on this account was applied to the refraction. The declinations were also corrected for aberration, &c. and the results were:

By 16 observations with TROUGHTON's instrument	18° 57′ 43″,5
By 16 observations with RAMSDEN's .	18 57 43 ,8
Mean latitude	18 57 44 N.

The place of observation was 1′ 37″ north of the Church, and 3′ 19″* north of the Light House. The latitude of the Church is therefore 18° 56′ 7″, and of the Light House 18° 54′ 25″ N.

It may be useful to remark upon a difference with RAMSDEN's sextant, in the results by the objects north, and by those south of the zenith in observing for the latitude; and also the difference in the results by the lunar observations east and west of the moon. The instrument was most carefully examined, and the error regularly found every day by measuring the sun's diameter; yet, notwithstanding, the following differences were in the results:

In the observations for the latitude, the object being North of the zenith . .	18° 58′ 11″
South of the zenith . . .	18 57 16,6
Difference †	0 55

* A survey was made for ascertaining this, as well as for the difference of longitude.

† From this difference in the results for the latitude, a difference of more than half a degree might be looked for in those of the longitude, as we find to be the case.

In the observations for the longitude, the object

being East of the ☽ . . .	73° 15′ 4″,4
West	72 40 46 ,2
Difference	34 18 ,2

The sextant by TROUGHTON, in the observations for the latitude, gave only a difference of four seconds between the results by the objects north, and those south of the zenith; and about three minutes in the observations for the longitude. Whether the differences in the results by the other sextant arose from an error in the total, or from what other cause, is not easy to determine. The instrument appeared perfect; but these results, however, show the necessity of observing objects both north and south of the zenith for the latitude; and also objects east and west of the moon for the longitude. The mean of the results thus obtained will be correct; the objects on one side, giving a longitude as much greater, as those on the other side give one as much less, than the truth. In consequence, we find that the mean latitude by RAMSDEN's instrument is only a few tenths of a second different from that by TROUGHTON's; while the mean longitude is only about sixteen seconds of a degree different.

J. GOLDINGHAM.

Madras,
6th December, 1819.